



## MEMORANDUM

To: Scott Mallory  
From: Kenneth Kaliski, P.E., INCE Bd. Cert.  
Subject: Calculation of sound levels for the proposed Velco Lyndonville substation  
Date: 10 June 2009

At your request, we conducted an analysis to predict the sound pressure level from the transformer at the proposed Velco Lyndonville substation.

The new substation is to include one transformer rated at 115/34.5 kV 33.6/44.8/56 MVA, and 550 kV BIL with a load tap changer. The transformer noise will be specified as not to exceed an A-weighted sound pressure level of 62 dB, which is 15 dB less than NEMA TR-1 standard at ONAF2 (fans on, second stage cooling). With ONAN (fans off), the transformer will not exceed 59 dB. The substation will also include two capacitor banks, although one will likely be in service at any one time.

These specifications are approximately the same as the Tafts Corner transformer, which is the quietest transformer in the Velco system.

The area surrounding the proposed substation is shown in Figure 1. The buildings to the south of the substation are commercial and industrial. The closest home is on a hillside to the west-northwest of the transformer, approximately 400 feet away.

Given the relatively low sound emissions from the transformer and the setbacks proposed, we conducted a simplified sound analysis based on the procedures found in Institute of Electrical and Electronics Engineers' IEEE Std 1127-1998(R2004), "IEEE Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility." This predicts the offsite sound level from a power transformer. It assumes straight-line sound propagation without attenuation due to atmospheric absorption, ground effects, foliage, or terrain. As a result, the model tends to be conservative.

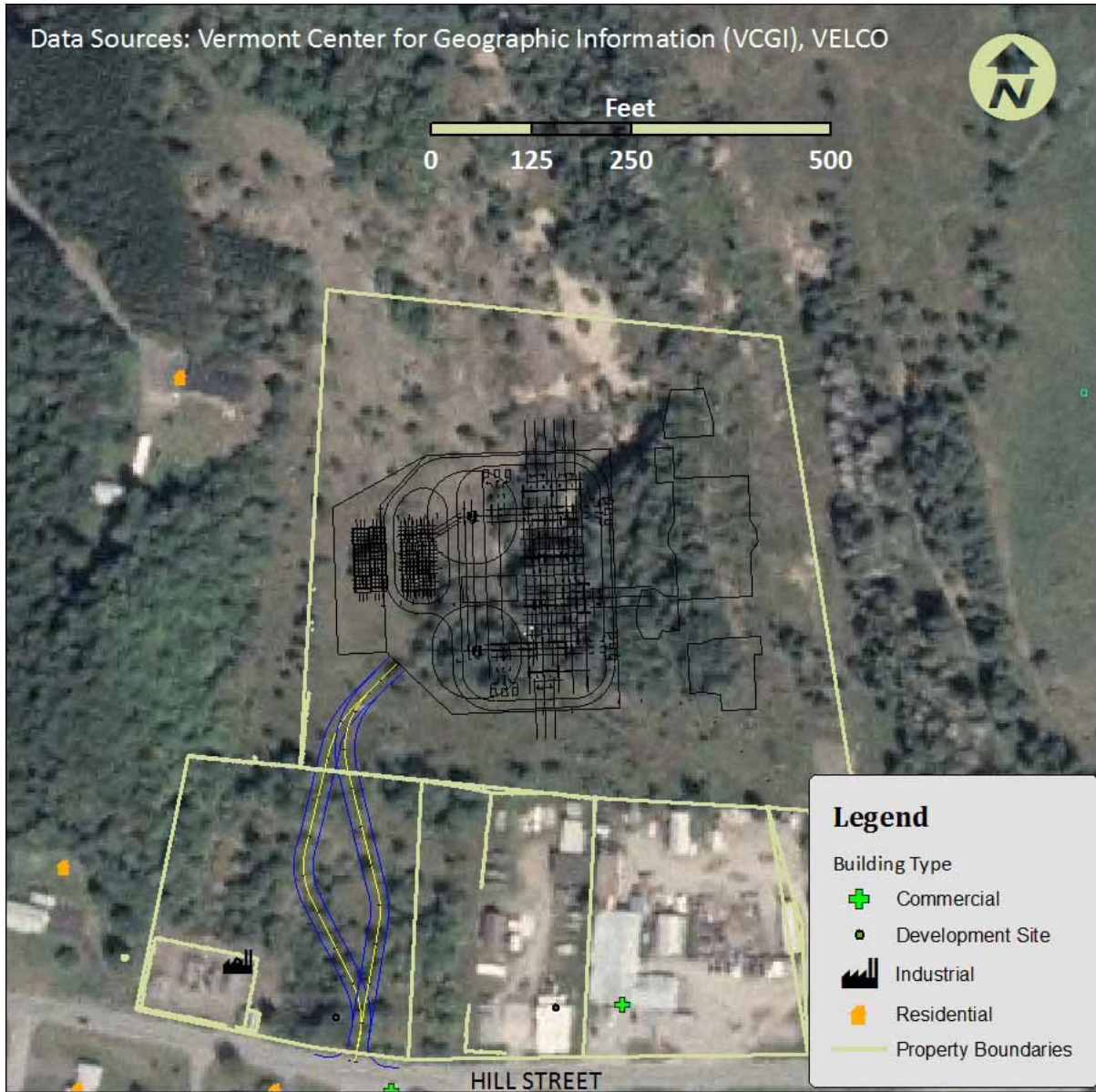
The capacitor bank was also modeled using a simplified procedure. From measurements made from a single direction from the Williston capacitor bank, we calculated an approximate sound power level of 81 dBA. To estimate the impacts at the nearest residence, we assumed spherical spreading, the ISO 9613-2 attenuation algorithm for geometric spreading. Again, we ignored

ground attenuation, foliage, and atmospheric attenuation which would serve to lower the sound pressure level at the nearest home.

The results of this analysis, which are attached to this memo, show that the resulting sound levels at the closest home will be approximately 31 dBA with fans off (ONAN) and approximately 33 dBA with fans on. These sound levels are consistent with a quiet rural area and well below Environmental Board and Section 248 precedent standards. As a result, the Lyndonville transformer will not have an undue adverse effect on aesthetics with regard to noise.



Figure 1: Plan view of substation and surrounding neighborhood



# Sound Pressure Levels at Remote Receivers as specified in IEEE Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility

IEEE Std 1127-1998(R2004)

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IEEE 1127 uses two formulas to calculate far-field sound levels from a transformer, denoted here as F1 and F2:

$$N_{F1} = -4.4 + dBT - 20 \log \frac{D}{\sqrt{WH}}$$

$$N_{F2} = 4.1 + dBT + 2.08 \log [(kV)(kVA)] - 20 \log D$$

## INPUT Parameters

Parameter	Symbol	ONAN	ONAF	
Specified Transformer sound level	dBT	59	62	dBa
Transformer Size (Self-cooled rating)	kVA	33600	33600	kVA
High-voltage winding (phase-to-phase)	kV	34.5	34.5	kV
Width of main tank or fan bank (ft)	W	24	24	Ft
Height of main tank (ft)	H	14	14	Ft
Distance from the transformer to receiver (ft)	D	400	400	Ft

## Calculated Transformer Sound Pressure Levels

Parameter	Symbol	ONAN	ONAF	
Using Formula F1 (dBA)	N	27.8	30.8	dBa
Using Formula F2 (dBA)	N	23.7	26.7	dBa

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## Capacitor Bank Sound Level

Assumes simple geometric spreading loss

$$L_w = L_p - 20 \log(r) - 11$$

Parameter	Symbol	Value	
Sound Power Level	L <sub>w</sub>	81	dBa
Sound Pressure Level at 400 feet	L <sub>p</sub>	28	dBa

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## Sum of transformer and one capacitor bank sound pressure level

Parameter	ONAN	ONAF	
Transformer Sound Level	28	31	dBa
Capacitor Bank Sound Level	28	28	dBa
<b>TOTAL SOUND PRESSURE LEVEL</b>	<b>31</b>	<b>33</b>	<b>dBa</b>